Galaxy 7000: Unitary Specification guide:
Single UPS, three-phase, 160 to 500 kVA

Specification guide
Single UPS, three-phase, 160 to 500 kVA (cont.)

1. UPS definition

1.1. Purpose

The purpose of this specification is to define the design, manufacture and testing characteristics required in view of supplying, putting into operation and maintaining an Uninterruptible Power Supply (referred to as a UPS hereinafter).
The UPS shall be designed to supply dependable electric power to:

_____

_____

1.2. Brief description

The UPS shall be a single UPS, operating in double-conversion mode (also called on-line mode); it shall be a VFI-type UPS (as per standard IEC 62040-2), made up of the following components, described in detail in this specification:
ω Rectifier
ω Battery charger
ω Inverter
ω Battery
ω Automatic bypass (via a static switch)
ω Manual bypass (for maintenance)
ω User and communications interface
ω Battery management system
ω Any and all other devices required for safe operation and maintenance, including circuit breakers, switches, etc.

2. Operating principles

The UPS shall operate in double-conversion mode as indicated below.

2.1. Normal operation
(normal AC source available)

The rectifier shall supply the inverter and the charger with DC current. The inverter shall continuously supply the load with backed up electrical energy and the charger shall float charge the battery.

2.2. Operation on battery power
(normal AC source not available or outside tolerances)

Upon failure or excessive deterioration of the normal AC source, the inverter shall continue to supply the load from battery power without interruption or disturbance, within the limits imposed by the battery backup time.

2.3. Battery recharging
(normal AC source restored)

When the normal AC source is restored, the rectifier shall again power the inverter, without interruption or disturbance to the load, while the charger automatically recharges the battery.

2.4. Transfer to bypass AC source

In case of a major overload or if the UPS shuts down, the static switch shall instantaneously transfer the load, without a break in the supply of power, to the bypass AC source if it is available and within tolerances.
Transfer of the load back to the UPS output, synchronized with the bypass AC source, shall be automatic or manual. During transfer, the load shall not suffer an outage or disturbance in the supply of power.
On request, the UPS system may automatically transfer the load with a micro-interruption (adjustable from 15 to 1000 ms) if a major fault occurs on the UPS system and if synchronization with the bypass source has not been established.

2.5. UPS maintenance

For maintenance purposes, the UPS shall include a mechanical manual bypass system with one-button operation. For personnel safety during servicing or testing, this system shall be designed to isolate the UPS while continuing to supply power to the load from the bypass AC source. The UPS shall also include a device making it possible to isolate the rectifier and the charger from the normal AC source.

All power and control electronics shall be accessible from the front of the UPS.

2.6. Battery maintenance

For safe maintenance on the battery, the system shall include a circuit breaker to isolate the battery from the rectifier, the charger and the inverter. When the battery is isolated from the system, the UPS shall continue to supply the load without interruption or disturbance, except in the event of a normal AC source outage.

2.7. Cold start (normal AC source absent)

The battery shall be capable of starting the UPS if the normal AC source is absent and continue supplying power to the load within the specified backup time. Cold start on battery power shall be possible on the condition that the system shall have started at least once on normal AC power.

3. Sizing and general characteristics

3.1. Technology

UPS technology shall be based on IGBT transistors for all the power converters (rectifier, charger and inverter with variable chopping frequency).

3.2. Rating

The UPS shall be sized to continuously supply a load of…[160/200250 / 300 / 400 / 500] kVA at a power factor of 0.9.

3.3. Battery backup time

The battery backup time in the event of a normal AC source outage shall be _____ minutes, for a load power factor of 0.9.
The battery shall be designed for a service life of …[10 / 12]…years. It shall be selected and sized correspondingly, for a load power factor of 0.9.

3.4. Types of loads accepted

The UPS shall accept high crest factors (3:1) without derating (kW) to ensure correct operation with computer loads and loads where the leading power factor can reach 0.9.
The total harmonic voltage distortion at UPS output (THDU downstream) shall respect the following limits:
ω THDU downstream ph/ph ≤ 3% for non-linear loads.

3.5. PFC sinusoidal-current input rectifier

The UPS system shall not draw a level of harmonic currents that could disturb the upstream AC system, i.e. it shall comply with the stipulations of guide IEC 61000-3-4.
The PFC input rectifier using sinusoidal-current IGBTs shall have the following performance levels:
ω Total harmonic current distortion (THDI) upstream of the rectifier not exceeding 5%,
ω Input power factor (PF) greater than 0.99 from 50% load upwards.

3.6. Output without a transformer

To reduce losses, dimensions and weight, the UPS output shall be of the transformerless type and the neutral shall be recreated electronically.

3.7. Efficiency

Overall efficiency (between the rectifier input and the UPS output) shall be greater than or equal to:
ω 94.5% from 50% load to full rated load (In).

3.8. Noise level

The noise level, measured as per standard ISO3746, shall be less than …[75 dBA (for160, 200, 250, 300, 400, 500 kVA)]

4. AC sources

4.1. Normal AC source

(rectifier input)

The normal AC source supplying the UPS shall, under normal operating conditions, have the following characteristics:
ω Rated voltage: 380 - 400 or 415 Volts rms at full rated load Pn
ω Input voltage range: 250 V (at 30% load) to 470 V
ω Number of phases: 3, a neutral is not required
ω Frequency: _____ Hz ± 10%

4.2. Bypass AC source

(automatic-bypass input)

The characteristics of the bypass AC source supplying the UPS in the event of an inverter shutdown (maintenance, failure) or an overload (short-circuit, very high inrush current) shall be the following:
ω Voltage:____/____ volts, ± 10%
ω Number of phases: 3 ph + N + earth (a non-distributed neutral is possible)
ω Frequency: _____ Hz ± 8% (adjustable up to ± 2 Hz)
Outside these tolerances, it shall be possible to supply the load, but in downgraded mode.

5. Electrical characteristics

5.1. Rectifier and charger

5.1.1. Power supply

The PFC rectifier, drawing sinusoidal current, shall be supplied by the normal AC source, without a neutral. It shall provide power for the load as well as charge or float charge the battery. The battery charger shall be supplied by the rectifier to avoid transmitting any AC fluctuations to the battery.

5.1.2. Inrush current

A device shall be provided to limit inrush currents.
When AC power fails and during genset start, the rectifier shall limit the power drawn by implementing a walk-in for ten seconds.

5.1.3. Phase sequence

A device shall check that the phase sequence is correct to protect the power system from the effects of incorrect connections. The device shall also check the bypass AC input.

5.1.4. Operating mode

The standard charger shall be sufficient to charge the battery rapidly. For a backup time of …[5 / 10 / 15 / 20 / 30] … minutes, battery recharging shall take less than …[4 / 6 / 7 / 8 / 9 hours]… (values after discharge to Pn/2 and recovery of 90% of total battery charge for a recent battery).

5.1.5. Input power factor

The performance level shall be that mentioned in section 3.5, i.e. PF > 0.99.

5.1.6. Charger regulation and monitoring

The battery recharge system shall include independent regulation and monitoring devices to ensure conformity with standard NFC 58311.
The battery recharge voltage shall be a function of the ambient temperature in the battery room.

5.2. Battery

The UPS shall be equipped with a battery of the …[sealed lead-acid type, mounted and wired in a cabinet identical in aspect to that of the UPS]…[sealed lead-acid type, mounted on shelves] …[vented lead-acid type mounted on racks]… and shall have a service life of …[10 / 12]… years.
The battery shall be sized to ensure a continuous supply to the inverter for at least …[5 / 10 / 15 / 20 / 30…]… minutes, in the event the normal AC source fails, given that the inverter is at full rated load, i.e. _____ kVA for a power factor PF = 0.9.
Sizing calculations shall assume an ambient temperature between 0°C and 35°C.

5.3. Inverter

The inverter shall be sized to supply a rated load of …[160/200/250 / 300 / 400 / 500]… kVA at 0.9 PF and shall satisfy the specifications listed below.

5.3.1. Output voltage

ω **Rated voltage**
…[380 / 400 / 415 / 440]… volts rms, adjustable via the user interface (see section 10), within tolerances of +/- 3% in order to take into account voltage drops in the cables.
ω **Number of phases**
3 phases + neutral + earth.
ω **Steady-state conditions**
Variations in the rated voltage shall be limited to ± 2% for a balanced load between 0 and 100% of the rated load, whatever the voltage level on the normal AC source and the DC voltage level, within the limits defined in sections 4.1 and 5.1.4.
ω **Voltage variations for load step changes**
Output voltage transients shall not exceed ± 1% of rated voltage for 0 to 100% or 100 to 0% step loads. In all cases, the voltage shall return to within steady-state tolerances in less than 100 milliseconds.
ω **Unbalanced conditions**
For a load unbalance between phases, the variation in the output voltage shall be less than 1%.

5.3.2. Output frequency

ω **Rated frequency**
-50 or 60 Hz.
ω **Variations in the free-running frequency**
- ± 0.5 Hz.

5.3.3. Synchronization with bypass power

ω **When bypass power is within tolerances**
To enable transfer to bypass power (see conditions in section 5.4), the inverter output voltage shall be synchronized with the bypass source voltage whenever possible. To that end, during normal operation, a synchronization system shall automatically limit the phase deviation between the voltages to 3 degrees, if the bypass source frequency is sufficiently stable (within adjustable tolerances of 0.5% to 8% with respect to the rated frequency).
ω **Synchronization with an external source**
It shall be possible to synchronize with all types of external source.
ω **Autonomous operation following loss of synchronization with bypass power**
When the bypass source frequency deviates beyond these limits, the inverter shall switch over to free-running mode with internal synchronization, regulating its own frequency to within ± 0.02 Hz. When bypass power returns to within tolerances, the inverter shall automatically resynchronize.
ω **Variation in frequency per unit time**
To avoid transmitting to the inverter any excessive frequency variations on the bypass AC source when it is within tolerances, inverter frequency variations per unit time (dF/dt) shall be limited to 1 Hz/s or 2 Hz/s (user defined).

5.3.4. Overload and short-circuit capacity

The UPS shall be capable of supplying for at least:
ω 10 minutes a load representing 125% of the rated load
ω 1 minutes a load representing 135 % of the rated load
ω 30 second a load representing 150% of the rated load.
ω For the specified power rating of …[160 / 200 /250 / 300 / 400 / 500]… kVA, the inverter shall be capable of current limiting to a peak capacity of ... [290 / 235 / 277 / 230 / 234 / 245%] ... for 150 ms to allow highly disturbed transient operating states without transferring the load to the bypass.
ω The overload capacity shall be capable of taking into account temperature conditions for more than ten minutes, by allowing a continuous, 10% overload when the temperature is less than or equal to 20°C.

5.3.5. Higher power ratings for lower temperatures

It shall be possible to increase the power rating when the temperature is less than 35°C. The rating can be raised by +3% for 30°C, +5% for 25°C and +8% for 20°C.

5.4. Automatic bypass

5.4.1. Load transfer to the automatic bypass

The UPS shall be equipped with an automatic bypass comprising a static switch. Instantaneous transfer of the load from the inverter to bypass power and back shall take place without a break or disturbance in the supply of power to the load, on the condition that the bypass source voltage and frequency are within the tolerances specified in section 4.2 and that the inverter is synchronized.
Transfer shall take place automatically in the event of a major overload or an internal inverter fault. Manually

initiated transfer shall also be possible.
If the bypass power is outside the specified tolerances or is not synchronized with the inverter, automatic transfer of the load from the inverter to bypass power shall be disabled or shall take place after a calibrated interruption adjustable from 15 to 1000 ms.

5.4.2. Static-switch protection

The static switch shall be equipped with an RC filter for protection against switching over voltages and lightning strikes.

5.4.3. Static-switch withstand

For the specified power rating of …[500 / 400 / 300 / 250 / 200 / 160]… kVA, the static switch shall be capable of handling an over current of …[16 / 16 / 21 / 25 / 18 / 23].… times the rated current of the UPS to facilitate discrimination within the electrical installation.

5.5. Discrimination and short-circuit capacity

If the bypass power is within the tolerances specified in section 4.2, the presence of the static switch shall make it possible to use the short-circuit power of the bypass source to trip the downstream protection devices of the inverter.
To ensure tripping in a selective manner, the available power shall be sufficient to trip protection devices with high ratings (circuit breaker rated In/2 or UR fuses rated In/4, where In is the rated inverter current).
If the bypass source is outside the specified tolerances, the inverter on its own shall, for the same discrimination requirements, be capable of tripping circuit breakers rated In/2 or UR fuses rated In/4, irrespective of the type of short-circuit.

5.6. System earthing (grounding) arrangements (SEA)

The UPS shall be compatible with the following system earthing arrangements (SEA):
ω Upstream source SEA: …[TT/ IT / TNS / TNC]…
ω Downstream installation SEA: …[TT/ IT / TNS / TNC]…
If the upstream and downstream SEAs are different, galvanic isolation shall be provided on the normal and bypass lines.

6. Mechanical characteristics

6.1. Mechanical structure

The UPS and batteries shall be installed in cabinet(s) with an [IP 20 / IP 32] degree of protection (standard IEC 60529). Access to the subassemblies making up the system shall be exclusively through the front.

6.2. Dimensions

The UPS shall require as little floor space as possible. To gain space, it shall be possible to install the UPS with the back to the wall or back to back with another UPS unit.

6.3. Connections

To facilitate connections, all terminal blocks must be easily accessible from the front when the UPS is installed with the back to the wall. Entry of upstream and downstream power cables, as well as any auxiliary cables, shall be possible through the bottom without requiring a false floor.
The UPS shall be equipped with an earth-circuit connector, in compliance with the standards listed in section 12.
The cables shall comply with the standards listed in section 12 and be mounted in compliance with the safety stipulations in section 6.6.

6.4. Ventilation

System cooling shall be by forced-air ventilation. To facilitate layout of cabinets (particularly when installed back to the wall), air input shall be through the front and bottom, exit through the top.
All power electronics shall be equipped with a redundant ventilation system including fault detection.

6.5. Safety

For the safety of maintenance personnel, the cabinet shall be provided with a manually operated mechanical bypass designed to isolate the rectifier, charger, inverter and static switch while continuing to supply the load from the bypass AC source.
The UPS shall be equipped with a terminal block for reception of an external EPO order resulting in opening of the battery circuit breaker and shutdown of all converters.

7. Environment conditions

7.1. UPS (not including battery)

7.1.1. Operation
The UPS, not including the battery, shall be capable of operating under the following environmental conditions without loss of performance:
- ω Temperature range during continuous operation: 0°C to 35°C
- ω Maximum temperature: 40°C for eight hours
- ω Recommended temperature range: + 20°C to + 25°C
- ω Maximum relative humidity: 95% at 25°C
- ω Maximum altitude without derating: 1000 m.

7.1.2. Storage
The UPS, not including the battery, shall be designed for storage under the following conditions:
- ω Ambient temperature range: - 10°C to + 45°C.

8. Protection

8.1. UPS

The UPS shall include protection against AC-source over voltages (as per standard IEC 60146), excessive external or internal temperature rise and vibrations and impacts during transport.

8.2. Rectifier and charger

The rectifier shall automatically shutdown if the temperature exceeds the limits specified in section 7.1.1.
The charger shall automatically shut down if the DC voltage reaches the maximum value specified by the battery manufacturer or if the temperature exceeds the limits specified in section 7.1.1.

8.3. Inverter

Inverters shall self-protect against overloads and short-circuits, irrespective of the operating mode (AC power or battery power).

8.4. Battery

8.4.1. Protection against deep discharge and self-discharge
The UPS shall comprise a device designed to protect the battery against deep discharges, taking into account the characteristics of the discharge cycles, with isolation of the battery by a circuit breaker.

8.4.2. Independent regulation and monitoring systems
A regulation system shall regulate the battery voltage and the charge current.
A second system, independent of the regulation, shall monitor the battery voltage and the charge current.
Consequently, if the regulation system fails, the monitoring system steps in to shut down the charger and avoid overcharging.

8.4.3. Regulation of the battery voltage depending on the ambient temperature
A temperature sensor adapts the charge voltage to the ambient temperature.
This regulation system takes into account the chemical reaction and prolongs the battery service life.
The permissible temperature range is set in the personalization parameters.
An alarm shall be issued for temperatures outside the permissible range.

9. Battery management

Batteries are components whose service life is sensitive to operating conditions, i.e. particular care is required for their management. In addition to the protective systems indicated in section 8.4, battery management shall include the systems listed below.

9.1. Self-test

The battery shall be equipped with a self-test that can be run:
ω On request via a manual control
ω Automatically according to user-set time intervals.
The self-test shall enable updating of battery parameters and detection of all abnormal conditions in view of preventive maintenance.

9.2. Measurement of actual backup time

The battery function shall be equipped with the means to know at all times the real backup time available (AC power available) or remaining (AC power not available), taking into account the true load on the inverter, the battery temperature and battery ageing.

9.3. Digital battery monitoring

The UPS shall be equipped with a system for battery digital management.
Based on a number of parameters (percent load, temperature, battery type and age), the system shall control the battery charge voltage and continuously calculate:
ω The true available backup time (section 9.2)
ω The remaining service life.

9.4. Block by block monitoring

To further optimize battery availability and service life, it shall be possible to equip the UPS with an optional system to continuously monitor all battery strings and display a block by block failure prediction. The system shall include the functions listed below.
ω Continuous measurement of the voltage of each block.
ω Continuous measurement of the internal resistance.
ω Identification of faulty blocks (trend curves).
ω Possibility of replacing individual blocks.
ω Removing of all information via Ethernet, dry contacts or JBus.

10. User interface and communication

10.1. User interface

UPS operation shall be facilitated by a user interface comprising:
ω a B&W graphical display
ω ON and OFF control buttons (independent of the display)
ω Status indications with mimic panel.

10.1.1. Graphical display

The mimic diagram shall enable display of installation parameters, configuration, operating status and alarms and indication of operator instructions for switching operations (e.g. bypass). It shall be capable of supervising a single UPS or a parallel system of up to eight UPS units with their SSC (static-switch cabinet).
ω **Display of measurements**
It shall be possible to display the following measurements:
- Inverter output phase-to-phase voltages
- Inverter output currents
- Inverter output frequency
- Voltage across battery terminals
- Battery charge or discharge current
- Rectifier/charger input phase-to-phase voltages
- Rectifier/charger input currents
- crest factor
- Active and apparent power
- Power factor of the load
- Battery temperature
- Battery percent charge
- Available backup time

- the remaining battery service life.

ω **Display of status conditions and events**
It shall be possible to display the following indications:
- Load on battery power
- Load on UPS
- Load on automatic bypass
- General alarm
- Battery fault
- Remaining battery backup time
- Low battery warning
- bypass AC source outside tolerances
- Battery temperature.

Additional information shall be provided in view of accelerating system servicing, as specified in section 11.

ω **Display of operating graphs**
It shall be possible to display bar graphs of the measurements mentioned above on the screen over significant periods.

ω **Statistics**
Number of overloads, number of transfers to battery power, cumulative time on battery power, maximum power levels, demand power levels.

ω **log of time-stamped events**
This function shall store in memory and make available, for automatic or manually initiated recall, time-stamped logs of all important status changes, faults and malfunctions, complete with an analysis and display of troubleshooting procedures. It shall be possible to time stamp and store at least 2500 events.

10.1.2. Controls
The UPS shall comprise the following controls:

ω **two ON and OFF buttons**
Located on the front panel of the UPS, they shall control UPS-unit ON/OFF status.
It shall be possible to turn OFF the UPS externally via an isolated dry contact.

ω **EPO terminal block**
The UPS shall be equipped with an emergency power off (EPO) terminal block for complete system shutdown following reception of an external control signal. The EPO command shall result in:
- Shutdown of UPS units
- Opening of the static switches on the bypass line and of the battery circuit breaker
- Opening of an isolated dry contact on the programmable card.

ω **Alarm reset button**
This button shall turn off audio alarms (buzzer) (see section 10.1.3). If a new alarm is detected after clearing the first, the buzzer sounds again.

10.1.3. Status indications with mimic panel
Indication of status conditions shall be distinct of the graphic display.
Three LEDs on the control panel indicate the following status conditions:
ω Load protected
ω Minor fault
ω Major fault.

The mimic panel shall represent the UPS and indicate the status of the load supply using five two-color (red and green) LEDs:
ω Load supplied (LED at UPS output on mimic panel)
ω Inverter on (inverter LED on mimic panel)
ω Operation on battery power (LED between battery and inverter on mimic panel)
ω Bypass activated (bypass LED on mimic panel)
ω PFC rectifier on (rectifier LED on mimic panel).

A buzzer shall warn the user of faults, malfunctions or operation on battery power.

10.2. Communication

10.2.1. Standard communication
It shall be possible to remote the following controls, indications and measurements. To that end, the UPS shall have as standard equipment:
ω a programmable card with four inputs and six outputs.

10.2.2. Communications options
The UPS shall be designed to enable the extension of communications, without system shutdown, to the following types of cards:
ω Multi-standard communications card with two outputs:
- an RS485 serial-link implementing the JBus/ModBus protocol for connection to a building management system (BMS)

- Ethernet 10/100 Mbps using one of the protocols below:
XML-Web for direct UPS connection to an intranet network, without connection to a server, capable of supplying information via a standard web browser
SNMP for connection to a computer-network management system
ω multi-standard communications card with three outputs:
- the two outputs listed above
- plus a modem output for communication with a tele-maintenance system.
ω The UPS shall be detectable by supervision software for large UPS systems.
ω Shutdown and administration software shall be available in addition to the communication cards.

11. Maintainability

A manual bypass shall be available to completely isolate the UPS for maintenance purposes.

11.1. Local and remote diagnostics and monitoring - E. Services

The UPS shall be equipped with a self-test system to check operation of the system as a whole each time it is started. To that end, the supply control/monitoring electronics shall offer:
ω Auto-compensation of component drift
ω Acquisition of information vital for computer-aided diagnostics or monitoring (local or remote);
ω Overall readiness for remote supervision services provided by the manufacturer.

12. Standards and tests

12.1. Standards

All equipment shall be designed and built in accordance with accepted engineering practice and applicable international standards, in particular the standards listed below.
ω IEC 60140-4: UPS - Performance.
ω IEC 62040-1 and EN 62040-1: UPS - Safety.
ω IEC 62040-2 and EN 62040-2: UPS - Electromagnetic compatibility (EMC), level B.
ω IEC 62040-3 and EN 62040-3: UPS - Performance.
ω IEC 60950 / EN 60950: Safety of IT equipment, including electrical business equipment.
ω IEC 61000-2-2: EMC, levels of compatibility.
ω IEC 61000-3-4: Limitation of emission of harmonic currents in low-voltage power supply systems for equipment with rated current greater than 16 A.
ω IEC 61000-4: EMC, immunity tests.
ω IEC 439: Low-voltage switchgear and control gear assemblies.
ω IEC 60529: Degrees of protection provided by enclosures (IP Code).
ω ISO 3746: Sound power levels.
ω CE marking.

What is more, the equipment shall comply with eco-design and eco-manufacturing criteria in view of sustainable development and to that end, the manufacturer shall be able to demonstrate:
ω R&D and production on an ISO 14001 certified site
ω Manufacture with over 90% recyclable materials
ω Capacity to recover products at the end of their service life and provide proof of destruction by a certified organisation
ω The environmental profile of the product, which shall be supplied with the sales offer.

12.2. Certification of conformity

The manufacturer shall provide, on request, a complete qualification file demonstrating compliance with the above standards. What is more, the indicated levels of performance shall be confirmed by certification from independent laboratories (e.g. TÜV or VERITAS).

13. Quality system and test procedures

13.1. Test procedures

The manufacturer shall provide proof of a quality-assurance system. In particular, the main manufacturing steps must be subject to suitable tests such as:

ω Inspection of incoming components, tests on discrete subassemblies
ω Complete functional checks on termination of manufacture.
The equipment shall be subject to burn-in under load conditions prior to shipping.
Final checks and adjustments shall be recorded in a report drafted by the quality-inspection department of the supplier.
Certification of the industrial facilities in compliance with ISO 9001 or 9002 shall be required.

13.2. Quality system

The UPS must be designed using an ISO 9001 quality system and a dependability study to ensure maximum reliability.

14. Services

14.1. Maintenance

The supplier shall propose contracts covering four levels of maintenance.
ω Level one: simple checks and settings, procedures accessible without any dismounting and involving no risk.
ω Level two: preventive maintenance, checks not inhibiting continuous operation of the system and preparing operators for Manufacturer services.
ω Level three: trouble-shooting. Repairs by standard exchange of subassemblies and functional power and control components. Preventive-maintenance operations, both systematic and when indicated by qualified diagnosis.
ω Level four: major preventive and corrective maintenance operations or technical upgrades during start-up, operation or renovation of the UPS installation and recycling of equipment or components representing a risk. These operations require the use of devices and means that have been calibrated by certified organizations.

14.2. Technical competency

ω Customer operators: the supplier shall offer a level 2 training program.
ω Service personnel: the supplier shall ensure that service personnel are qualified for level 4.

14.3. Functional components - organization of supplier services

ω Sufficient geographical proximity of the supplier or an authorized agent shall ensure reasonable access times to the customer site in view of reducing the mean time to repair (MTTR). The supplier shall be in a position to offer a contract limiting the response time to four hours.
ω The supplier's logistics system and the availability 24 hours a day of original replacement parts shall similarly contribute to reducing to the greatest extent possible the mean time to repair (MTTR).

14.4. System start-up

The system and equipment shall be started up on site by the supplier or its authorized agent. The procedure shall include checks on the characteristics of the upstream and downstream protection devices and on the UPS installation parameters.

14.5. Replacement parts

The suppler shall undertake to provide certified original replacement parts for at least ten years following the date of delivery.

14.6. Recycling and renovation/substitution

At the end of the UPS service life, the supplier shall guarantee the continuity of service of the customer's installations if necessary, including dismantling of equipment and replacement of equipment, in compliance with applicable standards on environmental protection.

15. Warranty

The rectifier, charger and inverter subassemblies shall be guaranteed (parts and labor on site) for one year following the start-up date.
The sealed lead-acid battery shall be covered by the same warranty as the UPS.

16. Further services

Required services include:
ω Supply of the UPS and any accessory parts or elements
ω Carriage-paid UPS transportation and delivery to the site.
Options:
ω UPS handling and installation on the site
ω Connections between the battery and the UPS
ω Connection of the normal AC source to the rectifier/charger
ω Connection of the bypass AC source to the input transformer or bypass input
ω Connection of the load circuits to the UPS output.

17. Electrical diagram

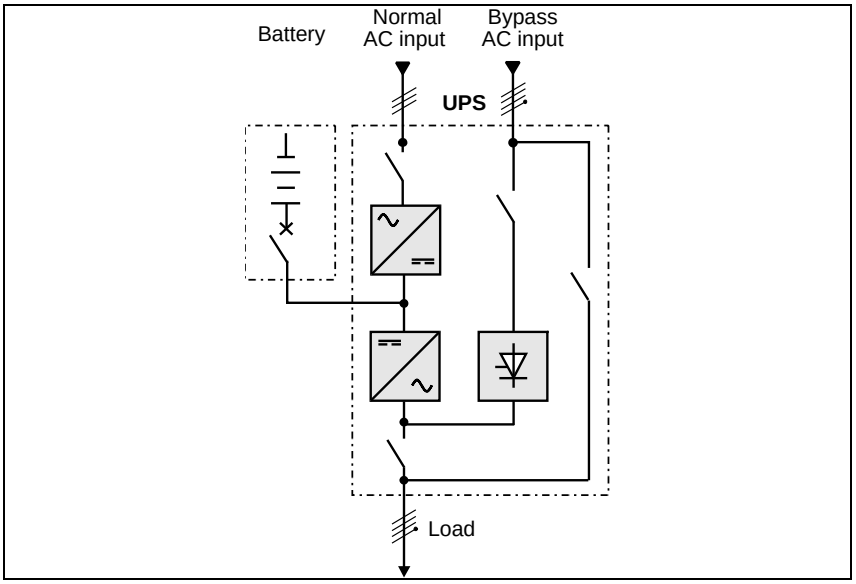

Fig. UPS electrical diagram.

Specification guide
Single UPS, three-phase, 160 to 500 kVA (cont.)

Appendix. Check list

Type of UPS						
Total rated power (kVA) at PF 0.9			kVA		kW	
Manufacturer						
Range of products						
Operating mode (IEC 62040-2)		double conversion	yes		no	
Operation as frequency converter			yes		no	
Rectifier						
Input voltage range:		250 V to 470 V	yes		no	
3-phase input		without neutral	yes		no	
Phase sequence		Check on phase sequence	yes		no	
Sinusoidal input current		THDI upstream ≤ 5% with PFC rectifier	yes		no	
Input power factor		PF > 0.99 with IGBT rectifier (from 50% load)	yes		no	
No inrush or start-up current			yes		no	
Rapid battery recharging		Typical 10-min. backup time recharged in six hours or less	yes		no	
Voltage regulation		± 1%	yes		no	
Independent regulation/monitoring systems for the charger			yes		no	
Battery						
Type	standard	sealed lead acid in a cabinet	yes		no	
	other		yes		no	
Service life		years	yes		no	
Backup time		minutes	yes		no	
Battery management and protection						
Recharge as a function of the temperature			yes		no	
Measurement of actual backup time, depending on load, temperature, age			yes		no	
Cold start on battery power			yes		no	
Protection against deep discharge		with circuit-breaker opening	yes		no	
Charge-current limiting		0.05 C10 to 0.1 C10 (depending on battery	yes		no	
Self-tests			yes		no	
Measurement of real backup time			yes		no	
Block by block monitoring			yes		no	
Prediction on end of service life			yes		no	

Specification guide
Single UPS, three-phase, 160 to 500 kVA (cont.)

Inverter					
Three-phase output voltage	☐ Volts	yes	☐	no	☐
adjustable within limits	± 3%	yes	☐	no	☐
Steady-state conditions	± 1%	yes	☐	no	☐
Voltage transients	± 5% (load from 0 to 100% or 100 to 0%)	yes	☐	no	☐
Output voltage distortion at Pn	THDU < 3%	yes	☐	no	☐
Unbalanced conditions	Voltage variation < 1%	yes	☐	no	☐
Output frequency	☐ Hz	yes	☐	no	☐
Variation in output frequency	± 0.5 Hz	yes	☐	no	☐
adjustable from	- 0.25 Hz to + 2 Hz	yes	☐	no	☐
Frequency synchronization with an external source	± 0.5% to ± 8% of rated frequency	yes	☐	no	☐
Overload capacity	125% In for 10 minutes	yes	☐	no	☐
	150% In for 30 seconds	yes	☐	no	☐
Current limiting	230% to 290% In for 150 milliseconds (e.g. 290% for 160 kVA and 200% for 300 kVA)	yes	☐	no	☐
Crest factor	up to 3:1	yes	☐	no	☐
Bypass functions					
Automatic bypass	With static switch	yes	☐	no	☐
Short-circuit withstand of static switch	16 to 25 In for 20 ms, depending on rating (e.g. 25 In for 250 kVA / 16 In for 500 kVA)	yes	☐	no	☐
Built-in manual bypass	Mechanical (for maintenance)	yes	☐	no	☐
Efficiency					
Normal mode	93 % (160 kVA) to > 94.5% from 75% load	yes	☐	no	☐
User interface					
Graphical display	selection of operating language from 19	yes	☐	no	☐
personalization menu	with password	yes	☐	no	☐
display	measurements, status, events, graphs	yes	☐	no	☐
event log	2500 time-stamped events	yes	☐	no	☐
bar graphs	power levels, backup time	yes	☐	no	☐
statistics	% time on battery power, number of transfers to battery power, average percent load, etc.	yes	☐	no	☐
Controls	ON, OFF, EPO terminal block	yes	☐	no	☐
Status indications with mimic panel	Audio alarm, LEDs	yes	☐	no	☐

Specification guide
Single UPS, three-phase, 160 to 500 kVA (cont.)

Communication						
Programmable relay card			yes		no	
EPO terminal block			yes		no	
Options	Card with two outputs	JBus/ModBus RS485 + Ethernet 10/100	yes		no	
	Card with three outputs	Same as 2-output card + modem +NMTC	yes		no	
	Supervision software		yes		no	
	Administration software	with shutdown management	yes		no	
Certification						
Certified standards and tests		See list in section 12.1	yes		no	
Performance certification		TÜV	yes		no	
Quality certification		ISO 9001 / 9002	yes		no	
Eco-design and manufacturing		ISO 14001 site	yes		no	
Services						
Technical competency of supplier		level 4 NFX 060-010	yes		no	
Diagnostics and monitoring		remote	yes		no	
Technical support		international	yes		no	
Operation, Maintainability						
Access to power components through front			yes		no	
Access to communication through front		hot-swap cards	yes		no	
Availability						
Availability of original replacement parts		around the world	yes		no	
Response time of Service teams			t < 4h	4<t<8	8<t<24	t>24 h
Maintenance programs		preventive	yes		no	
		predictive	yes		no	
Emergency services			yes		no	
Renovation / substitution programs			yes		no	